GUAM AGRICULTURAL EXPERIMENT STATION
ISLAND OF GUAM
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION

1926

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GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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GUAM AGRICULTURAL EXPERIMENT STATION
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REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION, 1926

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REPORT OF THE DIRECTOR

By C. W. Edwards

The director was absent from the station on a visit to the United States from July 2, 1925, to April 4, 1926. During this time Peter Nelson, administrative assistant, was in charge of station activities.

With the exception of a few days of high winds and heavy rains in July and again in August, climatic conditions generally were favorable to crop production. The rainfall was more equitably distributed and the dry season was of shorter duration than usually is the case.

Considerable much-needed repair and minor construction work was done, including the completing of the work of remodeling the swine house (fig. 1), rebuilding the residence water storage tank and tower (fig. 2), building a concrete and pipe railing on the flight of 75 steps leading to the station residence, constructing concrete seed flats 5 by 5 feet for the plant house, and making minor repairs to the barn, sheds, fences, and roads.

In addition to his other duties, the assistant in agronomy and horticulture, working in cooperation with the Department of Education, gave a series of lectures on agriculture to the normal-school class and acted as one of the judges of the school-garden exhibits.

On August 17, 1925, the governor appointed Frank Taitano as extension agent for the island. The station is cooperating with the governor in this work in every possible way. Members of the station staff devoted considerable time to making trips about the island in the interest of farmers who requested assistance on farm problems,

and in furthering extension activities and the agricultural work of the schools.

ANIMAL HUSBANDRY

COCONUT-FEEDING TESTS FOR SWINE

During certain seasons some of the local farmers allow their pigs to have free range. Often the feed of these animals consists entirely of fresh coconut. Cooperative tests were conducted at Cotot to compare the relative feeding value of coconut meal and fresh coconut as a supplementary ration for growing pigs and brood sows given free range on wood lot and open grassland.

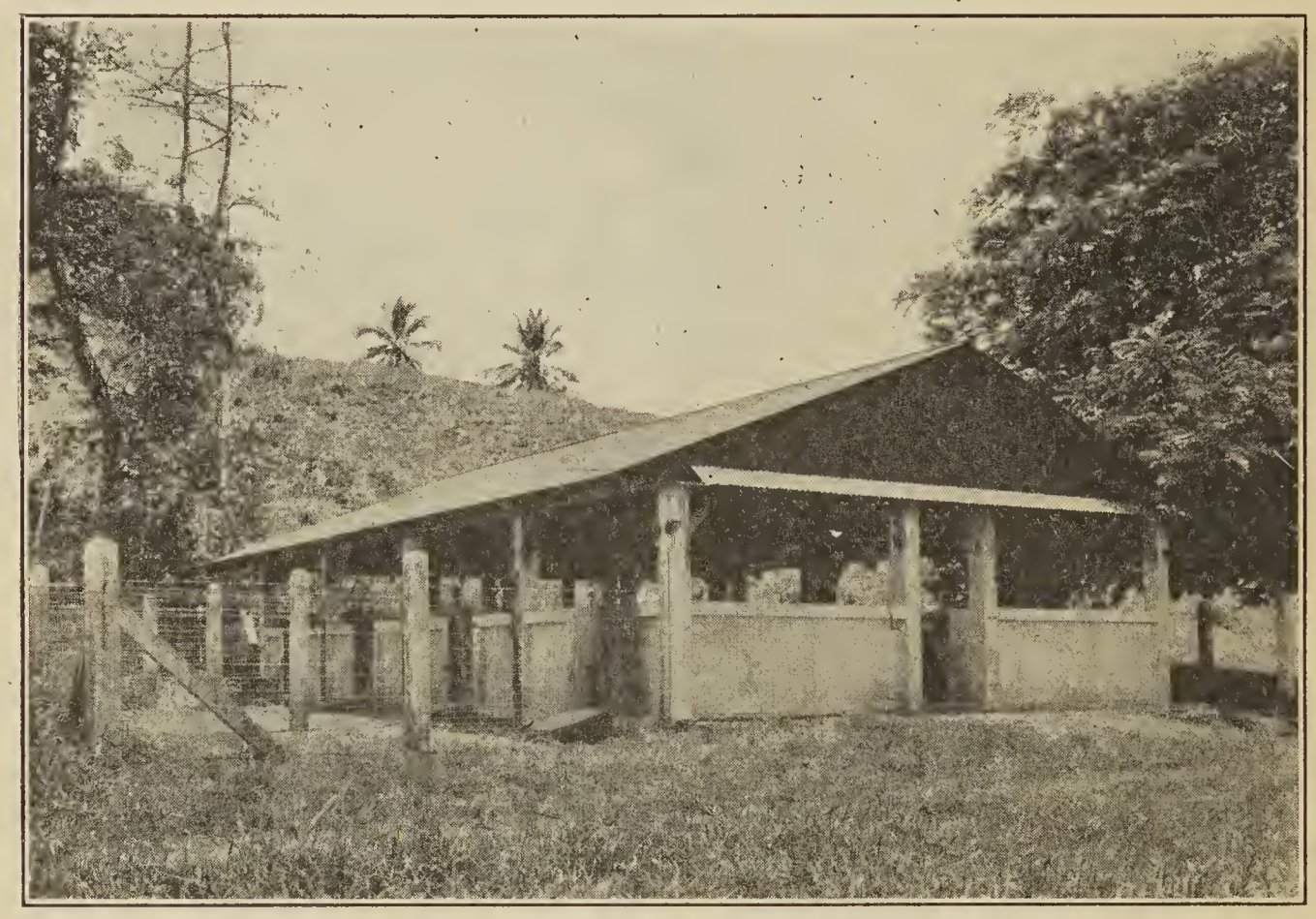

FIG. 1.—Remodeled swine house

TEST NO. 1. COCONUT MEAL FOR YOUNG PIGS

At weaning time 11 grade pigs averaging 39.8 pounds in weight at the beginning of the test were placed on free range and fed twice daily for a period of 92 days (August 18 to November 18) all they would eat of coconut meal. The lot made a total gain of 571 pounds, or an average daily gain of 6.2 pounds, and consumed 1,178 pounds of coconut meal. The pigs made an average daily gain of 0.56 pound each and consumed an average of 1.25 pounds of meal per day. A total of 206 pounds of feed was required to produce 100 pounds of gain. The cost of the feed per 100 pounds of gain was $2.58.

TEST NO. 2. COCONUT MEAL FOR YOUNG PIGS

Fifteen weanling pigs averaging 30.5 pounds in weight at the beginning of the test were fed and handled in the same manner as those in test No. 1 for a period of 91 days (December 17 to March 18). The lot made a total gain of 532 pounds, or an average daily gain

of 5.85 pounds, and consumed 1,376 pounds of coconut meal. The pigs made an average daily gain of 0.39 pound each and consumed an average of 1.27 pounds of meal per day. A total of 259 pounds of coconut meal, costing $3.24, was required to produce 100 pounds of gain.

TEST NO. 3. FRESH COCONUTS FOR GROWING PIGS

Eight weanling grade pigs averaging 25.63 pounds in weight at the beginning of the test were placed on free range and fed all they would eat of fresh coconuts twice daily for a period of 91 days (December 17 to March 18). The lot made a total gain of 316 pounds, or an average daily gain of 3.47 pounds, and consumed 1,076 pounds of coconuts. The pigs made an average daily gain of 0.43 pound per head. A total of 341 pounds of the feed was required to produce 100 pounds of gain. The cost of the coconuts per 100 pounds of gain was $3.41.

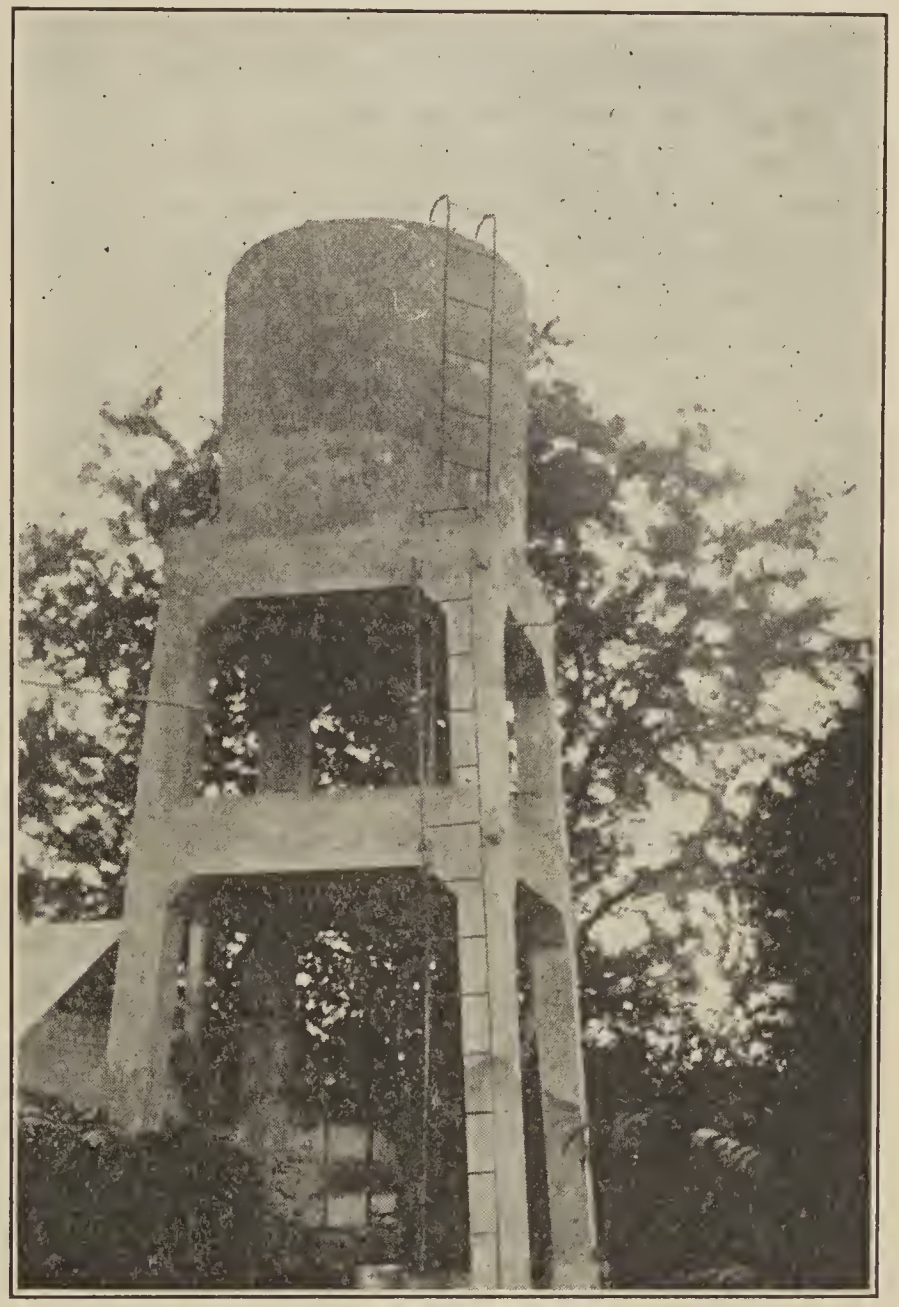

FIG. 2.—Concrete water-supply tank and tower

TEST NO. 4. FRESH COCONUTS FOR GROWING PIGS

Ten grade weanling pigs averaging 32.9 pounds in weight at the beginning of the test were fed and handled in the same manner as those in test No. 3 for a period of 59 days (February 18 to April 18). The lot made a total gain of 248 pounds, or an average daily gain of 4.2 pounds, and consumed 776 pounds of fresh coconuts. The pigs made an average daily gain of 0.42 pound each. A total of 313 pounds of the feed was required to produce 100 pounds of gain. The cost of the feed per 100 pounds of gain was $3.13.

TEST NO. 5. COCONUT MEAL VERSUS FRESH COCONUTS FOR SOWS WITH PIG AND THOSE NURSING THEIR LITTERS

During the period of gestation and the time they were nursing their litters, sows Nos. 324 and 325 were fed coconut meal and sows Nos. 326 and 335 fresh coconuts. Throughout the test the sows were allowed free wood-lot and open grassland range except for about six weeks

when they were confined to the pen because of their failure to return to the ranch at feeding time. The animals were hand fed twice daily, receiving all they would eat.

Sows Nos. 324 and 325 each consumed a daily average of 2.8 pounds of coconut meal during the period of gestation and 8.4 pounds during the time they were nursing the litter, whereas sows Nos. 326 and 335 consumed a daily average of 4.4 pounds of fresh coconuts per head during gestation and 9 pounds during the time of nursing the litter.

There was no appreciable difference in the total cost of the feed of the two lots. In connection with the quantity of feed consumed, consideration must be given to the fact that some of the feed was eaten by the litters previous to weaning. However, the total number of pigs of the two sows receiving coconut meal was the same as that of the two fed fresh coconuts. From the date of service to the time of weaning of the litters the two sows fed coconut meal lost a total of 46 pounds, whereas the two animals fed fresh coconuts lost a total of 69 pounds.

Sow No. 326 showed lameness about three weeks before the close of the test and later developed a paralytic condition of the hind quarters. A few similar cases have been observed on ranches where the animals were fed only coconuts. This condition apparently is brought about by feeding a ration lacking in minerals. For several weeks following the close of the test sow No. 326 refused to eat coconuts or any feed having the odor of fresh coconut. Sow No. 335 also failed to relish the coconuts toward the close of the test. Sows Nos. 324 and 325 ate the coconut meal with relish throughout the test and apparently without ill effect.

The meal used in the tests was the product of the local oil mill, and only fairly well-matured nuts were fed.

COMPARISON OF RESULTS OF FEEDING TESTS

A comparison of the results shows that the two lots of pigs receiving coconut meal in tests 1 and 2 made an average daily gain of 0.48 pound per head, whereas those receiving fresh coconuts in tests 3 and 4 made an average daily gain of 0.43 pound per head. The feed was listed at the prevailing local market price of 1¼ cents per pound for coconut meal and 1 cent each for mature coconuts in the husk. The nuts used approximated 1 pound of meat each. Daily feed consumption, daily gains, the amount of feed required to produce each pound of gain, and the cost per pound of gain are noticeably low. There is little difference in average daily gain and feed per pound of gain between the lots fed coconut meal and those fed fresh coconuts. A comparison of the gains (cost of feed only) shows an appreciable difference in favor of the coconut-meal-fed lots. As above stated, the cost of the fresh coconuts was calculated at 1 cent each, the price paid for fresh nuts sold for human consumption. However, with copra at 3 cents per pound, the copra value of the nuts would be somewhat less. On the other hand, the labor of gathering and splitting the nuts made the cost of feeding fresh coconuts considerably higher than that of feeding the meal. In this case the coconuts were cut in half and fed from the shell.

If the meat is extracted as is done by some of the local farmers the labor cost of feeding is further increased.

Although the pigs made gains at an unusually low cost of feed, the gains were so low as to indicate that neither fresh coconuts nor coconut meal makes a satisfactory entire ration for pigs of the age of the animals tested, even when they are allowed free range. During the period the tests were under way breadfruit and other seasonal crops which are relished by pigs were not available on the range. At the close of the tests the pigs receiving the fresh coconuts carried more flesh than those fed coconut meal, but the latter showed a greater height and length of body.

That coconut meal seemed to be more palatable to the pigs than were the fresh coconuts was shown principally by the greater promptness of the meal-fed lots in returning to the pens at feeding time. In fact, the test with the second lot fed coconuts was discontinued at the end of 59 days because of the disinclination of the pigs to appear at feeding time. Preceding the time the litters were weaned and placed on test, each litter and its dam were given the same kind of feed as was fed during the test.

POULTRY

The purebred Rhode Island Red stock was disposed of in order that the work with poultry might be directed on a larger scale toward the production of a new variety by crossing the native stock with improved breeds. Owing to the limited facilities of the poultry plant and the financial inability of the station to enlarge it, only one poultry project can be properly carried on at present.

DISEASES

In response to requests for advice concerning poultry-disease problems, the assistant in poultry husbandry made numerous visits to ranches in various parts of the island. Diseases were prevalent throughout the island. The greater part of the losses was due to outbreaks of chicken pox. The results obtained on some of the ranches where advice relative to the control of the disease was followed indicate that much of the loss could have been prevented by giving the flock proper management. Chicken pox has attacked the station flocks each year for the past several years, but each time the disease has been quickly eliminated with little loss of life by promptly isolating the sick fowls, giving them epsom salts, and treating the lesions with creolin or mercurochrome.

RESISTANCE OF CANTONESE CHICKENS TO CHICKEN POX

According to local opinion the Cantonese variety of chicken is resistant, if not immune, to chicken pox. To determine whether or not such an opinion is supported by fact a test was conducted in which 10 Cantonese and 10 common grade fowls of various ages were placed in a double-fenced area and exposed to the disease. Two diseased fowls were introduced into the flock, one showing early symptoms and the other well-developed stages of the disease. Twenty-two days later none of the flock showed signs of having con-

tracted the disease. At this time artificial means of transmitting the disease were employed by scarifying the combs of all the birds in the control lot with an infected knife. Within the next 16 days all of the grade and nine of the Cantonese fowls contracted the disease. One Cantonese was not affected, and a Cantonese chick, 48 days old at the beginning of the test, died. Results of the test show that the local opinion is erroneous. Probably the risk of infection is reduced to the minimum by reason of the docile disposition and the small combs and wattles of the Cantonese as compared with the Leghorns, for example; but the Cantonese fowl seems to be no more resistant or immune to chicken pox than is the average grade fowl.

REPORT OF THE ASSISTANT IN AGRONOMY AND HORTICULTURE

By Joaquin Guerrero

Notwithstanding a more equitable distribution of rainfall than usual and a dry season of comparatively short duration, the first showers of April were followed by a dry period which necessitated replantings. No very destructive storms occurred, plant diseases and pests were less severe than is often the case, and conditions on the whole were favorable to crop production.

FORAGE CROPS

Forage-crop investigations were confined principally to introduced species appearing to give the most promise and to be of greatest value for Guam conditions. Former trials extending over many years have shown that *Paspalum dilatatum* and Para grass have the greatest local value of any of the pasture grasses so far introduced. Of the coarser forages, Napier (*Pennisetum purpureum*) and Guatemala (*Tripsacum laxum*) are the most promising.

About 2½ acres of stony hillside, where very little of the soil is visible, was planted with *Paspalum dilatatum* to test its adaptability to limestone areas. Contrary to expectations, the planting made very satisfactory growth. The results show that Paspalum may be successfully grown on similar areas in the northern part of the island.

EFFECT OF BURNT LIME (LOCAL) AND GROUND CORAL LIMESTONE ON YIELD OF NAPIER GRASS

A gradually increasing interest is being shown in the planting of improved forage crops for pasture and soiling purposes. When the dry season is at its height many of the native grasses are wholly inadequate for the proper subsistence of cattle on range pasture. Paspalum grass should be planted to improve the pastures, and in addition coarse forage should be grown as a soiling crop to tide the stock over the dry season. Napier grass has shown itself to be well adapted for this purpose. Often the yield of Napier grass, especially on lowland soils, may be increased by treating the area with lime. Two forms of lime are available, a burnt coral limestone from the native kiln and a ground, raw limestone (cascajo). (Figs. 3 and 4.)

FIG. 3.—Native lime kiln before burning

FIG. 4.—Native lime kiln after burning

To compare the effect of these two forms of lime on yield of Napier grass, a test was begun on lowland soil which had been in Paspalum for the past 14 years. The soil is the heavy clay type characteristic of the lowlands of the southern part of the island. The test was made on two one-ninth-acre plats separated by two guard rows. One plat was treated with burnt lime at the rate of 1 ton per acre, and the other with ground cascajo at the rate of 10 tons per acre. The first cutting was made 175 days after planting when the plants were 7 to 8 feet high. Only two cuttings were obtained up to the close of the fiscal year. The plat receiving cascajo produced the highest yield of forage. Apparently cascajo offers an inexpensive material for use in improving sour lowland soils. (Fig. 5.)

EFFECT OF COCONUT MEAL ON YIELD OF NAPIER GRASS

One plat which was treated with coconut meal (local) at the rate of one-half ton per acre gave a lower yield than did either of the two lime-treated plats, but considerably more than the plat receiving no treatment.

FERTILIZER TEST WITH FORAGE CROPS

This is a continuation of work previously reported[1] in which Napier and Guatemala grasses and Japanese cane are being treated with burnt lime (local), manure, and burnt lime and manure in combination, to learn the effect on yield. Results during the year showed that in the case of Napier grass the plat treated with lime and manure in combination gave the highest yield of forage, followed by the plat receiving lime alone. In the case of Japanese cane, the plat receiving manure alone yielded the most forage, followed by the plat receiving lime and manure in combination. In the case of Guatemala grass the lime treatment produced the best results and the combination treatment the poorest yield.

ADAPTABILITY TEST

In the test begun last year to determine the comparative adaptability of Japanese cane (*Saccharum officinarum*), Napier grass, Guatemala grass, Merker grass (*Pennisetum merkerii*), and *P. setosum* to rocky limestone hillsides overlain by thin clay soil, three cuttings were obtained from all plats except the Japanese-cane plat which yielded only two cuttings. Napier grass made the most rapid growth and showed the highest degree of resistance to drought, and Japanese cane made the poorest showing. Napier grass gave the highest yield, followed by Guatemala, Merker, and *P. setosum* grasses, and Japanese cane, in the order mentioned.

JALA MAIZE

A small sample of seed corn of Jala maize, received from the United States Department of Agriculture for trial at the station, was planted April 16, 1925. (Fig. 6.) Jala maize is said to be a late-maturing variety, requiring 8 to 10 months to produce a crop.

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[1] GUERRERO, J. REPORT OF THE ASSISTANT IN AGRONOMY AND HORTICULTURE. GUAM Agr. Expt. Sta. Rpt. 1924 : 7–8, 1926 ; 1925 : 10, illus. 1926.

FIG. 5.—Fertilizer test with Napier grass (*Pennisetum purpureum*). A, Plat 1, which received burnt lime at the rate of 1 ton per acre; B, plat 3, a check; and C, plat 4, which was given cascajo at the rate of 10 tons per acre

The ears and stalks are much larger than those of ordinary corn. On June 12, 1925, a few stalks started to tassel and eight days later one stalk began to send out silks. On July 6, 1925, most of the ears were in the milk stage and some of them measured approximately 15 inches long with 14-inch shanks. About this time the plat was so seriously damaged by high winds and a stalk disease which is prevalent at times in many parts of the island, that no mature seed could be obtained.

FIG. 6.—Jala maize

HENEQUEN

In a test begun to determine the adaptability of certain fiber crops to local conditions, 100 bulbils of henequen (*Agave fourcroydes*) were obtained from the Office of Fiber Investigations, United States Department of Agriculture. The young plants were first grown in the nursery and on August 3, 1925, were transplanted in the field. The area selected is a rock limestone hillside having very thin soil. At the close of the year the plants averaged 6 inches in height.

LEGUMES

ALFALFA (MEDICAGO SPP.)

A few seeds were obtained from two small plats of the varieties Chinese and Province. The original seed of these varieties was received from South Africa. A plat of the variety Hunter River failed to survive the period of heavy rains.

COVER-CROP EFFICIENCY TEST

Cover-crop investigations were continued. Plantings were made of Patani beans, seguidillas, Lamao Lima beans, Black Mauritius and Yokahama velvet beans, native, black, and rice mungo beans, and Groit and Hawaiian hybrid cowpeas. The seguidillas failed to make a satisfactory cover crop due to poor seed germination. The Black Mauritius velvet bean efficiently covered the area for a

period of 171 days. The mungo varieties made only a fair cover crop. To be of service for this purpose they must be closely planted. The Hawaiian hybrid and Groit cowpeas made a fairly good cover crop. In another planting of Hawaiian hybrid cowpeas made September 19, 1925, the plants occupied the ground until January 12, 1926, or for a period of 115 days, when the vines were disked and turned under as green manure. Seguidillas, planted January 18, 1926, failed to keep down weed growth until 74 days after date of planting. Slow growth was probably due in part to the fact that the crop was grown during the period of light rains. The pigeon peas after two years are still effectively keeping down weed growth. *Tephrosia candida* was no longer efficient as a cover crop two years and four months after date of planting, and *T. hookeriana* had ceased to cover the ground effectively a month earlier.

During the year the station received from the Hawaii Experiment Station 10 varieties each of cowpeas and soy beans, and one variety of pigeon peas. Some of these varieties were grown for the first time in Guam. The soy beans failed to germinate. The cowpeas gave a good germination. The latter were grown to test their comparative efficiency as a cover crop and to obtain seed for further planting. The Victor variety of cowpea produced the densest growth, followed by the varieties Iron, Hawaiian hybrid, and Groit, in the order named. Early Buff was the earliest to fruit, but made the poorest cover crop and occupied the ground for the shortest period of time.

ROOT CROPS

SWEET POTATOES (IPOMOEA BATATAS)

Many farmers have been growing improved varieties of sweet potatoes in place of the local kinds since the station introduced the improved varieties in 1923. Of the improved varieties, Porto Rico is generally preferred to the others, because of its good cooking quality and comparatively high yields. Only fair yields are obtained at the station because of the fact that the soils are for the most part unsuited to the crop. The imported varieties gave the following estimated acre yields: Southern Queen, 2,800 pounds; Nancy Hall, 2,600 pounds; Yellow Jersey, 2,200 pounds; Triumph, 6,200 pounds; Porto Rico, 6,600 pounds; Pumpkin, 1,650 pounds; Yellow Strasburg, 3,050 pounds; and Big Stem Jersey, 6,000 pounds. In another test, the native varieties gave the following estimated acre yields: Amarillo, 1,825 pounds; Patas Ñgañga, 575 pounds; Peru, 2,150 pounds; and Yap, 2,500 pounds. The varieties Mamaka, Dago, and Alalag also were tested but failed to give any appreciable yield of tubers, the growth being confined to foliage.

In the work begun August 14, 1925, to determine the effect of fertilizers on yield of sweet potatoes, the superphosphate (acid phosphate) and nitrate of soda plat in the test for that year produced 5,700 pounds of roots; the superphosphate and sulphate of ammonia plat, 4,700 pounds; the superphosphate and coconut meal plat, 6,800 pounds; the superphosphate and sulphate of potash plat, 5,100 pounds; the superphosphate and manure plat, 6,000 pounds; the superphosphate, coconut meal, and sulphate of potash plat, 3,100 pounds; the superphosphate, nitrate of soda, and sulphate of potash plat,

4,900 pounds; the superphosphate, sulphate of ammonia, and sulphate of potash plat, 5,500 pounds; and the check plat, 4,600 pounds. All plats in this test were planted with the variety Porto Rico. The crop was harvested January 5, 1926.

Coconut meal was used as a substitute for nitrate of lime, the supply of which had become exhausted. The amounts of coconut meal applied were calculated to furnish nitrogen equal to that supplied by the nitrate of lime in earlier plantings. In the 1925–26 test superphosphate and coconut meal in combination produced the highest yield, followed closely by superphosphate and manure in combination. Superphosphate, sulphate of potash, and coconut meal in combination produced less than the check plat.

YAM (DIOSCOREA SPP.)

In the 1925–26 test with imported (two varieties) and native (six varieties) yams, begun to determine the effect of trellising on yield, the estimated acre yields were as follows: *Dioscorea latifolia*, nontrellised 2,808 pounds, trellised 2,080 pounds; *D. alata*, nontrellised 7,280 pounds, trellised 11,752 pounds; Red yam, nontrellised 4,680 pounds, trellised 7,904 pounds; White yam, nontrellised 3,224 pounds, trellised 2,080 pounds; Haya, nontrellised 3,224 pounds, trellised 4,160 pounds; Nika, nontrellised 4,576 pounds, trellised 3,328 pounds; Thorny Wild, nontrellised 2,080 pounds, trellised 1,456 pounds; and Thornless Wild, nontrellised 4,992 pounds, trellised 5,408 pounds. In four instances the trellised plats outyielded the nontrellised, and in four other instances the reverse was true.

MISCELLANEOUS INVESTIGATIONS

Economic plants introduced during the year include the propagating material of several varieties of grapes, *Ingallana guama*, pejibaye palm (*Guilielma utilis*), French cherry, guava, star apple, varieties of avocado, papaya, and sweet potato, and a number of ornamentals, among which are a few varieties of hibiscus new to Guam.

ORCHARD

The area of the orchard was extended, about 1½ acres being added during the year to help take care of the various plant introductions. Trial introductions producing their first fairly good crop of fruit include the Barbados cherry (*Malphigia glabra*), jujube (*Ziziphus jujuba*), several varieties of avocado, and *Citrus aurantium* (B. P. I. No. 36971). The latter, because of its apparent freedom from local citrus diseases, is now being grown for use as stock material.

The citrus trees were attacked by scaly bark (probably psorosis), a teneid leaf miner, a leaf roller, and a buprestid beetle. Successful methods of combating the pests have not as yet been developed. Scraping the infected area, disinfecting the wound with bichloride solution, and applying Bordeaux paste to it proved to be an effective control measure for scaly bark.

Selection work with papayas was continued, but apparently little progress is being made in the attempt to eliminate variations within

the given type. The round type shows greater variation than does the long type.

A cultural test with bananas was started October 1, 1924, stalks in various stages of growth and suckers of different type being planted to determine what kind of material is the most suitable for propagating purposes. Of the several methods tried, the plantings of whole unpruned stalks, about two-thirds grown, were the first to produce fruit. The quality of the fruit, however, was poor and the bunches were very small. Most of the plants have just begun to fruit and yield records are not therefore available.

EXPERIMENTS WITH TRUCK CROPS

In the work with garden vegetables, selection and crossbreeding of tomatoes was continued, variety tests with cabbage were made, and fertilizer tests with coconut meal conducted to learn the effect on yield of vegetables.

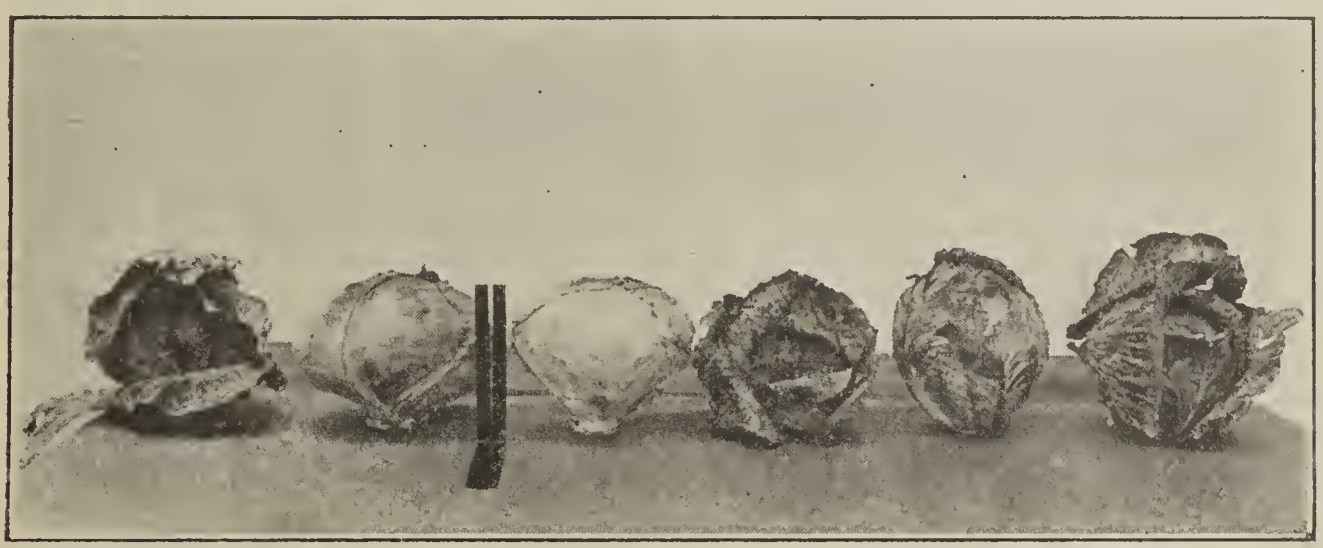

FIG. 7.—All Seasons variety of cabbage

CABBAGE

After many unsuccessful attempts in previous years to obtain a head-producing strain, head cabbage was successfully produced this year during the season of light rains. Of six varieties tested All Seasons (fig. 7) and Surehead alone gave satisfactory results. The work will be continued to test the behavior of these and additional promising varieties during other seasons, and also to learn whether success this year was due to an unusual combination of favorable conditions or whether certain varieties possess a satisfactory degree of adaptability to local conditions. (Fig. 8.)

FERTILIZER TESTS

Work to determine the effect of coconut meal on the yield of certain vegetables was continued. In this year's test the meal was applied to carrots, radishes, and Kentucky Wonder beans. The plats treated at the rate of 500 pounds per acre produced 3,570.5 pounds of beans, 6,845 pounds of carrots, and 14,957.25 pounds of radishes per acre. The plats receiving 1,000 pounds produced 4,754.5 pounds of beans, 6,808 pounds of carrots, and 23,254.5 pounds of radishes per acre. The plat receiving 1,500 pounds yielded 3,755.5

pounds of beans, 5,744.25 pounds of carrots, and 33,355.5 pounds of radishes per acre. The check plat gave a yield of 2,312.5 pounds of beans, 6,327 pounds of carrots, and 13,597.5 pounds of radishes per acre.

The estimated acre yields of Chinese White Winter radishes, planted December 18, 1925, and harvested February 5, 1926, were as follows: From plats treated with 400 pounds of nitrate of soda, 13.6 tons; with 300 pounds of sulphate of ammonia, 10.8 tons; with 131 pounds of floranid (urea), 14.3 tons; with 231 pounds of leuana saltpeter, 10.8 tons; with 15,000 pounds of fresh cow manure, 20.2 tons; with 4,285 pounds of chicken manure, 27.6 tons; with 12,000 pounds of horse manure, 19.1 tons; with 1,700 pounds of coconut meal, 20.3 tons (fig. 9.); with 388 pounds of calcium nitrate,

FIG. 8.—Variety test of cabbages. Left to right, Florida Drumhead, Surehead, All Seasons, and Flat Dutch Centennial

17 tons; and with 15,000 pounds of carabao manure, 18.8 tons. The first check plat yielded 20.1 tons and the second check plat 18.4 tons.

SEED AND PLANT DISTRIBUTION

The station continued to control the sale and distribution of seed purchased by the naval government of Guam. Approximately 1,326 packets of vegetable seed were sold to the general public at cost, and 74.5 pounds and 41 packets were furnished free of charge to the various government departments. The general distribution of seeds and plants imported and grown by the station included 26 grafted mangoes, 120 grafted Citrus, 17 avocados, 1,974 pepper plants, 806 tomato seedlings, 755 eggplants, 59 Isabella grape cuttings, 591 papaya plants, 4 chico plants, 139 pineapple suckers, 3,500 lettuce plants, 1 mangosteen, 305 teak seedlings, 3 sacks of

sweet-potato cuttings, 136 packets of vegetable seeds, 156 sacks of grass roots, 153 other economic plants, and 2,517 miscellaneous ornamentals.

REPORT OF THE ENTOMOLOGIST

By S. R. VANDENBERG

COCONUT BUD ROT

An extensive campaign against coconut bud rot was instituted because of serious outbreaks of the disease during the year. Over 100 authentic cases occurred as compared with only 5 during 1924–25, and many more were reported that could not be verified. Drastic

FIG. 9.—Radish fertilizer test. Plat 6, which received 4,285 pounds of chicken manure, yielded at the rate of 27.6 tons per acre; plat 8, which was treated with 1,700 pounds of coconut meal, yielded at the rate of 20.3 tons per acre

cutting and burning measures were resorted to as the only means of control for infected trees. In order to win the cooperation of the farmers in eradicating the disease the station published timely articles in English and in Chamorro giving information about the disease, and held frequent meetings in the various districts to discuss the need of quick and concerted action for bud-rot control. The control work was in charge of the insular patrolmen stationed in the various districts.

Experiments in transmitting bud rot were made during the year, a group of three coconut trees in an isolated place being used for the purpose. Pure cultures of bacteria were isolated from a virulent case of bud rot and poured among the crown leaves of one tree and injected into the base of the crown shoot of another. The third tree was left to serve as a check. The test gave negative results.

Further experiments were held in abeyance, as it was decided that the value of the knowledge gained would not warrant the danger of spreading the disease. Coconut products are the only articles of export and are the chief means of livelihood of the farm population in Guam.

COCONUT SCALE

During 1925–26 the death sentence was pronounced on the coconut scale (*Aspidiotus destructor*) as far as its economic importance in Guam is concerned. As an emergency method of control in 1924 infested leaves were cut and burned in the more severely attacked areas. This method temporarily checked the scale, but killed innumerable beneficial insects which were breeding in such numbers that they would later have been able to effect a control. With the advent of the rainy season in July, 1925, the parasites and predators began to gain the ascendancy, and by the end of January, 1926, the scale was greatly reduced in numbers. The damage done by the scale was everywhere evident in the mottled yellow color of the leaves and the scurfy-looking remains. With the coming of the dry season from January to July, the scale began to increase in numbers until at present when another rainy season is imminent the pest is in evidence in most of the localities, though in smaller and therefore less damaging numbers than previously. Now it is always found attended by one or more of its natural enemies.

The small black ladybird beetle (*Cryptogonus orbiculus* var. *nigripennis*) has been found to be the most important natural enemy of the coconut scale in Guam. The important internal parasites which were mentioned in the last annual report [2] as *Aphelinus diaspidis* and *Aspidiotiphagus citrinus* were identified by Timberlake of the Citrus Experiment Station, Riverside, Calif., as *Aphelinus chrysomphali* and *Aspidiotiphagus agilior*. These internal parasites are of importance in the order named, the Aphelinus attacking the female scale, and *A. agilior* the male scale. The male scale is rarely seen in the field, due to the efforts of the minute *A. agilior*. The value of *A. agilior* for scale control is, however, much reduced by the apparent ability of the female scale to reproduce parthenogenetically. An entomogenous fungus (*Cephalosporium lecanii*) which was discovered attacking the scale has been propagated and distributed on *Aspidiotus destructor* and *Asterolecanium bambusae*.

The finding in June, 1925, of a small isolated plantation of coconuts in the Dededo district afforded an exceptional opportunity for a study of the efficiency of natural enemies of the coconut scale in the field. This plantation of approximately 3 acres of young trees 2 to 6 years old not only was surrounded by forest but also lay at least one-half to three-quarters of a mile from any other coconut plantation. Half the area was found to be heavily infested, and the obviously advancing edge to carry a lighter infestation. Observations showed that the parasite *Aphelinus chrysomphali* was generally distributed over the infested area, but the small black ladybird beetle *Cryptogonus orbiculus* var. *nigripennis* was well established on only two or three trees and lightly on those trees immediately surrounding

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[2] VANDENBERG, S. R. REPORT OF THE ENTOMOLOGIST. Guam Agr. Expt. Sta. Rpt. 1925: 18. 1926.

them. It was concluded therefore that *A. chrysomphali* had been present for some time and possibly from the beginning of the infestation but had failed to check the scale, and also that the ladybird beetle had found its way to the area within the few preceding months and perhaps one or two years following the infestation. Subsequent inspection bore out these conclusions inasmuch as the ladybird beetle continued to increase in numbers and spread rapidly until four months afterward (October) it had gained control and two months later had reduced the scale to the point of extermination. During the dry weather of the winter and spring months the scale began slowly to increase in numbers. Isolated colonies were observed on almost all the trees, but usually were confined to only a few leaflets. In no instance at this time could a live colony of scale be found unattended by the larvae and adults of *C. orbiculus*. This was the situation in June when the rains were imminent. The infestation had spread over the 3 acres during the year, but had been caught up with and subdued by the ladybird beetle.

The history of this 3-acre area may be considered as typical in a small way of both the area and the time of the scale infestation and its control over the entire island. The ability of the scale to increase faster during the dry than during the rainy season is due to the frequent rains of the latter season which are almost invariably accompanied by wind, often of high velocity. The structure and manner of attachment of the coconut leaf is such as to permit exposure by a wind of low velocity (10 to 15 miles per hour) of the underside on which the scale is to be found. The insect after secreting its scale-covering is little affected by rain, but the newly hatched larvae which crawl out from under the parent and the young scales which are not yet protected by secretion, are washed off and smothered in large numbers. The scale in all stages is intolerant of prolonged tropical sunshine. The central upright leaves of a very heavily infested coconut tree, the underside of whose lower and middle leaves are plastered with scale, are practically free from scale and remain a vivid green in striking contrast to the greenish yellow of the lower infested leaves.

The importations of the ladybird beetle *Lindorus lopanthae* from California as a means of controlling the coconut scale failed, but an importation of this beetle from Hawaii was successful. However, when a colony of the latter was placed on an infested tree in the field along with the *Cryptogonus orbiculus*, it failed to establish itself, whereas the *C. orbiculus* increased rapidly.

OTHER IMPORTANT INSECTS

Importations from Hawaii of *Novius cardinalis* (Vedalia) to combat the cottony cushion scale have been very successful, large numbers having been bred and colonies distributed to every locality where the host could be found. In all instances these colonies established themselves and rapidly subdued the scale. After practically exterminating the cottony cushion scale the Vedalia disappeared, due to its inability to propagate itself on other than this host, which fact will probably necessitate a reintroduction of this predator every few years.

The omnivorous ladybird *Cryptolaemus montrouzieri* also was imported from Hawaii and bred for distribution throughout the island to combat mealybugs and *Pulvinaria* sp. (probably *P. psidii*). The presence of ants on the host material of this insect made its propagation rather difficult and somewhat reduced its efficiency in the field.

A shipment of the tachinid fly *Ceromasia sphenophori*, which is parasitic on the sugar-cane borer *Rhabdocnemis obscura*, was received from the Hawaiian Sugar Planters' Association, Honolulu. The flies were liberated in an infested cane field. The shipment was made in three lots. In the first lot 24 puparia were placed in a test tube containing a few strands of excelsior and transported in one of the ship's staterooms. Eight flies issued, of which three died within a few hours and five were liberated. Puparia probably dried out too much. In the second lot 56 puparia were placed in a mason jar containing cane frass and borer cocoons and transported in the vessel's chill room. The puparia were received in a water-logged condition but upon being dried 19 flies issued of which 5 were weak and soon died and 14 were liberated. In the third lot 77 grubs of the cane borer each were placed in a small vial containing sugar cane for food and transported in one of the ship's staterooms. The material in about one-half the vials—unfortunately those containing the parasitized grubs—was attacked by a blue and a white fungus. Of the 77 grubs, 49 were parasitized, of which 35 died and 14 produced 35 parasitic puparia. These 35 puparia were removed from the vials to prevent attack by mold. Twelve adults emerged of which 3 were weak and soon died and 9 were liberated.

Many of the liberated parasites although robust enough either failed to fly well or at all because of malformed wings resulting from improper moisture conditions during pupation. The second lot was the most successful, but the flies which were liberated from the third lot were superior in activity.

The European corn borer (*Pyrausta nubilalis*) did much damage to the corn crop during the year. Two importations of the parasite *Exeristes roborator* were received from the United States field laboratory of the Bureau of Entomology at Arlington, Mass., to combat the pest. From the first lot only one female and three males were recovered. From the second lot 42 females and 53 males were liberated in a heavily infested cornfield the owner of which was requested to allow the stalks to remain intact after harvesting. This was not done, the stalks being cut and burned.

Partly successful attempts were made to breed the parasite in the laboratory. Only males resulted, which indicated that the parent females used had not been properly fertilized notwithstanding the fact that insects of both sexes were kept together in the breeding cage for a number of days. Further efforts to establish the parasite will be made.

Several insects not previously recorded as occurring in Guam have been identified or sent out for identification. Some of them are of economic importance as pests and include the potato tuber moth (*Phthorimaea operculella*); the Florida wax scale (*Ceroplastes floridensis*), which was found on the mango and a shade tree (*Cassia florida*); and the oblique-banded leaf roller (*Archips rosaceana*), which was observed infesting the leguminous camachile tree.

MISCELLANEOUS NOTES

Experiments in growing potato sprouts as food for different kinds of scales and mealybugs for use in propagating beneficial insects met with indifferent success. Potatoes are not produced in Guam and those available are obtained through the naval supply department. The source is not constant and the potatoes are of poor quality. However, potatoes were obtained from which good sprouts resulted when grown in a cool, dark place. Most of the sprouts deteriorated before a proper degree of infestation could be obtained when they were infested with insects and brought up to the light and temperature of the insectary. Conditions probably could be remedied by erecting the proper buildings and equipment for the purpose, but the cost is not justified under present conditions. Local plants, grown under natural conditions, must of necessity be the main source of food for insects in any breeding experiments undertaken.

A good start on a collection of Guam insects was made, the insects being pinned in new boxes acquired for the purpose. The specimens became moldy and infested with book lice when the rainy season was well started. The boxes were found to be lined with composition cork, and the material which was used as a binder absorbed moisture from the air. Extra sections of this material when exposed directly to the air in the office became sodden and covered with mold. Despite all efforts, the collection was ruined. Nothing less than pure cork is suitable for insect boxes in the humid climate of Guam.

METEOROLOGICAL OBSERVATIONS, 1925–26

Observations made at the station on temperature, precipitation, and wind are summarized in Table 1.

TABLE 1.—*Condensed meteorological data for the year ended June 30, 1926*

Month	Temperature					Total precipitation	Prevailing direction of the wind
	Maximum	Minimum	Mean maximum	Mean minimum	Monthly mean		
1925	°F.	°F.	°F.	°F.	°F.	*Inches*	
July	90.0	73.0	86.20	75.72	80.96	26.07	Northeast.
August	89.5	72.0	86.50	76.17	81.33	19.75	West.
September	91.0	73.0	86.86	76.71	81.78	9.21	Do.
October	91.0	73.0	87.20	76.19	81.69	16.18	Northeast.
November	90.5	72.5	88.35	76.69	82.52	7.83	Do.
December	90.0	72.5	87.26	75.73	81.49	4.46	East.
1926							
January	89.0	72.5	86.33	74.39	80.36	3.95	Do.
February	89.0	72.0	86.76	73.78	80.27	1.52	Northeast.
March	88.5	71.0	86.61	73.98	80.29	2.06	Do.
April	91.0	71.0	89.18	73.53	81.35	.80	Do.
May	91.0	73.0	89.37	75.94	82.65	.59	Do.
June	91.5	73.5	89.01	76.38	82.69	4.97	Do.
Total						97.39	

The weather during the year may be considered as having been normal, and the rainfall sufficient to make ideal growing conditions. No disastrous storms occurred.

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